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FAUNA OF THE TYPE TEJON: ITS RELATION TO
THE COWLITZ PHASE OF THE TEJON
GROUP OF WASHINGTON

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INTRODUCTION.

The Tejon group of California has a very characteristic fauna and, partially on this account, strata of this group have been recognized easily in many places throughout this state and in the neighboring states of Oregon and Washington.

An examination of the fauna of the type locality of the Tejon on Cañada de las Uvas has revealed many new species and many species described from other localities. The fauna as a whole does not represent the entire assemblage of the forms of the Tejon group, but only one zone appears to be present. The discovery in the type Tejon of several new species which had been described from the Washington Eocene has led to this comparison of the Washington Eocene fauna with that of the type Tejon.

This paper deals with the faunal relations of the Cowlitz phase of the Tejon group of Washington and that of the type locality of the Tejon in California. In brief, the conclusions of this comparative study are that the Cowlitz phase is in reality identical with the faunal assemblage from the typical Tejon at Cañada de las Uvas, and that both faunas belong to a middle zone of the Tejon group which will be called the *Rimella simplex* Zone.

HISTORICAL.

The first recognition of Eocene on the Pacific Coast was made by Conrad,¹ and was based upon the fossils contained in a boulder sent by Blake from Cañada de las Uvas.

Conrad described the following new species: *Cardium lineatum*, *Dosinia alta*, *Meretrix uvasana*, *Meretrix californiana*, *Crassatella uvasana*, *Mytilus humerus*, *Volutilithes californiana*, *Busycon* (?) *blakei*=(*Perissolax blakei*), *Clavatula* (?) *californica*=(*Fusus californicus*), *Natica alveata*=(*Amauropsis alveata*), and he identified *Venericardia planicosta*, *Natica ætites* (?), *Natica gibbosa* and *Crassatella alta* of the Claiborne Eocene.

¹ Pacific Railroad Reports, App. to Prelim. Geol. Rept. of W. P. Blake, Palaeontology, pp. 5-20, 1855. Reprinted in Pacific Railroad Reports, vol. 5, part 2, pp. 317-329, 1857.

Concerning this occurrence Conrad states that "The Eocene period is unequivocally represented, by the beautifully perfect shells from the Cañada de las Uvas, which, though not found in situ, are evidently derived from strata occurring on the Pacific slope of the Sierra Nevada. This is very remarkable, inasmuch as three species correspond with forms of Claiborne, Alabama, and seem to indicate a connection of the Atlantic and Pacific oceans during the Eocene period. The vast distance between the two localities will account for the general distinction of species, and it was indeed, an unexpected result to find any identical. If I had imagined any eastern species to occur in California, it would have been the very one which does occur, and apparently in abundance, that 'finger post' of the Eocene, *Cardita planicosta*, a fossil of the Paris Basin, and also abundant in Maryland, Virginia and Alabama. This species originated and perished in the Eocene period, and is so widely distributed that it may be regarded as the most characteristic fossil of its era. As the boulder from which these shells were derived was quite small, and yet furnished thirteen species, when it shall be investigated in situ, doubtless a great many other forms will be obtained, and very likely some with which we are already familiar in eastern localities. Although the rock is a very hard sandstone, the shells may be exposed in great perfection by careful management, and we look forward with great interest to their further development, and to the discovery of the rock in situ."

Gabb² in 1864 described many species which Captain Horn collected from the vicinity of Cañada de las Uvas and referred the strata yielding this fauna to Division B of the Cretaceous. Whitney³ in the next volume described the type locality of the Tejon-Eocene as follows:

"The Tejon group . . . the division B of Palaeontology, vol. 1, is peculiar to California. It is found most extensively developed in the vicinity of Fort Tejon and about Martinez. From the latter locality it forms an almost continuous belt in the Coast Ranges to Marshs', 15 miles east of Mount Diablo, where it sinks under the San Joaquin plain. It was also dis-

² Gabb, Wm., *Geology of California, Palaeontology*, vol. 1, 1864.

³ Whitney, J. D., *Geology of California, Palaeontology*, vol. 2, p. 19 of preface, 1869.

covered by the different members of the survey at various points on the eastern face of the same range as far south as New Idria, and in the summer of 1866 by Mr. Gabb in Mendocino County, near Round Valley, the latter locality being the most northern point at which it is as yet known.”.

“This group contains a large and highly characteristic series of fossils, the larger part peculiar to itself, while a considerable percentage is found extending below into the next group (Martinez)”.

For several years the controversy concerning the age of the Tejon was waged. Conrad,⁴ Gabb,⁵ Whitney,⁶ Cooper,⁷ Marcou,⁸ Heilprin,⁹ Newberry,¹⁰ White,¹¹ Becker,¹² Clark,¹³ Harris,¹⁴ Diller,¹⁵ all contributed to this question. The cretaceous ghost of the Tejon was finally laid by Stanton¹⁶ and Merriam.¹⁷ Most of the papers cited deal with the Tejon in general, and direct references to the type locality are few in number.

⁴ Conrad, T. A., “Observations on Certain Eocene Fossils described as Cretaceous, by W. M. Gabb in his Report published in “Palaeontology of California”, *Am. Jour. Conchol.*, vol. 1, pp. 362-365, 1865; “Further Observations on Mr. Gabb’s Palaeontology of California”, *Am. Jour. Conchol.*, vol. 2, pp. 97-100, 1866; “Check list of Invertebrate Fossils of North America, Eocene and Oligocene”, p. 37, *Smithsonian Misc. Coll. No.* 200, 1866; *Am. Jour. Sci.*, 2nd series, vol. 44, pp. 376-377, 1867.

⁵ Gabb, W. M., Reply to Mr. Conrad’s Criticism on Mr. Gabb’s Report on the Palaeontology of California”, *Am. Jour. Conchol.* vol. 2, pp. 87-92, 1866; *Amer. Jour. Sci.*, 2nd series, vol. 44, pp. 226-229, 1867; On the Subdivisions of the Cretaceous Formation in California, *Cal. Acad. Sci. Proc.*, 1st series, vol. 3, pp. 301-306, 1867; *Geol. Surv. California, Palaeontology*, vol. 2, 1869.

⁶ Whitney, J. D., *Geol. Surv. California, Palaeontology*, vol. 2, 1869.

⁷ Cooper, J. G., “The Eocene Epoch in California—Are there really no Eocene strata?”, *Cal. Acad. Sci. Proc.*, 1st series, vol. 5, pp. 419-421, 1874.

⁸ Marcou, J., *Am. Rept. Geol. Surv. West 100° Merid.*, pp. 167-169, 1876; “Note sur la geologie de la Californie”, *Bull. Soc. geol. France*, 3rd series, vol. 11, pp. 407-435, 1883.

⁹ Heilprin, A., “On the Occurrence of Ammonites in Deposits of Tertiary Age”, *Proc. Acad. Nat. Sci. Phila.*, vol. 34, p. 94, 1882; “On the Age of the Tejon Rocks of California, and the Occurrence of Ammonitic Remains in Tertiary Deposits”, *Proc. Acad. Nat. Sci., Phila.*, vol. 34, pp. 196-214, 1882.

¹⁰ Newberry, J. S., “On Supposed Tertiary Ammonites”, *Proc. Acad. Nat. Sci. Phila.*, vol. 34, pp. 194-195, 1882.

¹¹ White, C. A., On Marine Eocene, Fresh Water Miocene and other fossil Mollusca of Western North America, *Bull. 18, U. S. Geol. Surv.*, pp. 7-9, 1885.

¹² Becker, G. F., “Notes on the Stratigraphy of California”, *Bull. 19, U. S. Geol. Surv.*, pp. 1-25, 1885.

¹³ Clark, Wm., “Correlation Essays, Eocene”, *Bull. 83, U. S. Geol. Surv.*, pp. 95-110, 1891.

¹⁴ Harris, G. D., “Correlation of the Tejon with Eocene Stages of the Gulf Slope”, *Science*, vol. 22, p. 97, 1893.

¹⁵ Diller, J. S., *Bull. Geol. Soc. Am.*, vol. 4, pp. 218-220, 1893.

¹⁶ Stanton, T. W., “The Faunal Relations of the Eocene and Upper Cretaceous on the Pacific Coast”, 17th Annual Report, *U. S. Geol. Surv.*, pp. 1011-1059, 1896.

¹⁷ Merriam, J. C., “The Geological Relations of the Martinez Group of California at the Typical Locality”, *Jour. Geol.*, vol. 5, pp. 767-775, 1897.

The reader is referred to the papers by Clark and Stanton for a more complete review of the literature concerning the age and correlation of the Tejon.

Anderson¹⁸ mapped an area in the southern end of the San Joaquin Valley which included the Type Locality of the Tejon group and he described the stratigraphic relations there.

Weaver¹⁹ first discovered and described the Cowlitz phase of the Tejon group in Washington. The interesting new species described by him in this paper were so numerous that the complexion of the fauna suggested that a new phase of the Eocene was discovered on the Pacific Coast and he named the rocks containing this fauna the Cowlitz formation. Since then Dr. Weaver has withdrawn this formational name, and he now recognizes these strata as a member of the enormously thick Tejon group of Washington.

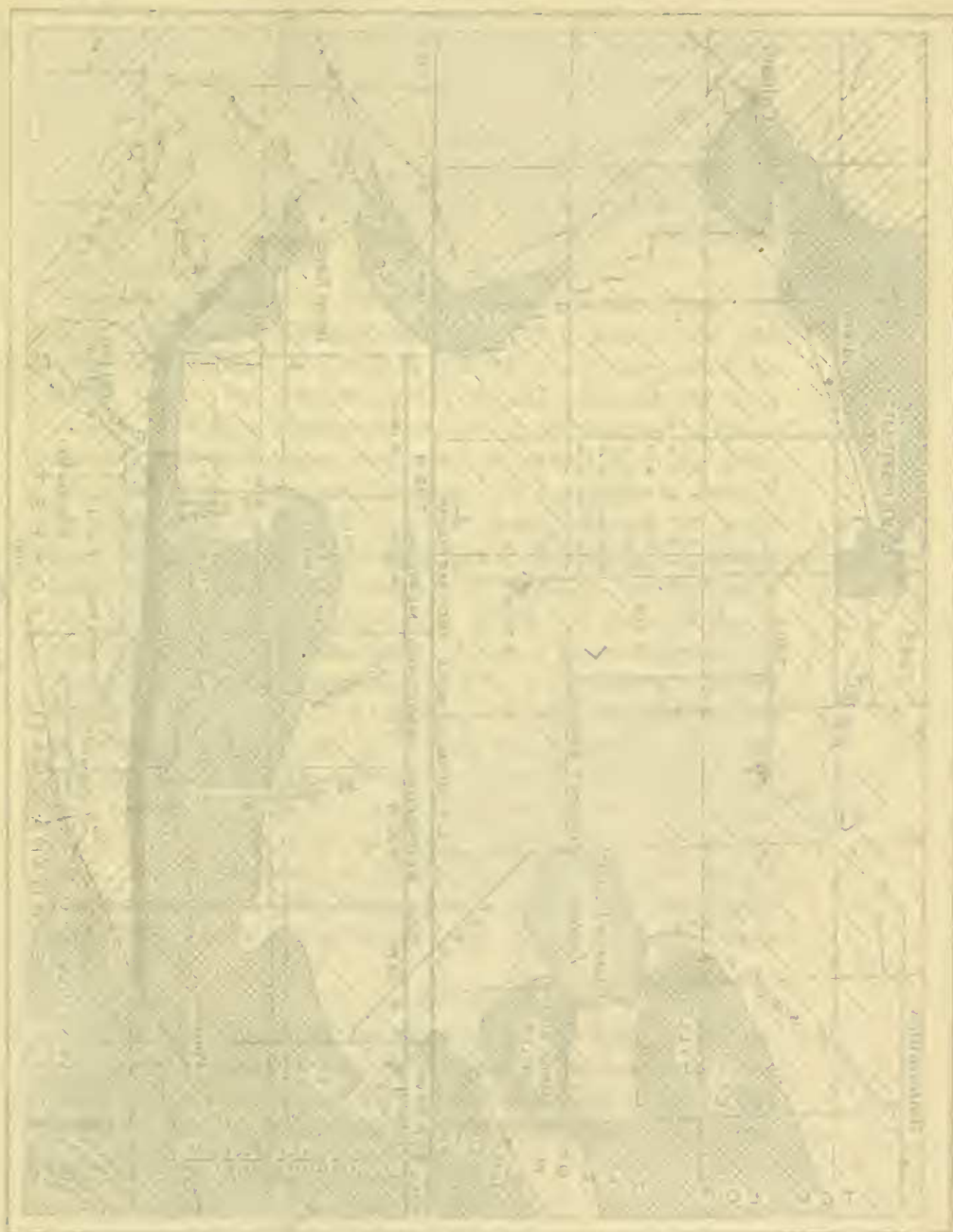
Arnold and Hannibal²⁰ listed species from Weaver's type locality and included the strata which yielded this fauna in the "Chehalis formation, Tejon series." They state concerning the fauna of their Chehalis formation that "No equivalent strata have been recognized elsewhere in the northwest but the Tejon of the type locality near old Fort Tejon in California evidently represents the same faunal stage. In many respects the Chehalis fauna is similar to that of the succeeding Olequa formation, but the floras are markedly different, that of the Chehalis formation lacking the distinctly tropical facies of the later divisions of the Tejon, and thus affording a most characteristic feature." If the plants were found at horizons of about the same age as the marine beds then the foregoing conclusions concerning climate do not agree with the evidence of the marine shells, which indicate a warm temperate or subtropical condition. It is possible that the plant beds are not the same in age as the marine beds of the Cowlitz phase.

¹⁸ Anderson, R. V., "Preliminary Report on the Geology and Possible Oil Resources of the South End of the San Joaquin Valley, Cal.", Bull. 471, U. S. Geol. Surv., pp. 117-119, 1912.

¹⁹ Weaver, C. E., "A Preliminary Report on the Tertiary Palaeontology of Western Washington", Bull. 15, Wash. Geol. Surv., pp. 12-15, 1912.

²⁰ Arnold, Ralph, and Hannibal, Harold, *The Marine Tertiary Stratigraphy of the North Pacific Coast of America*, Proc. Am. Phil. Soc., vol. 52, pp. 567-569, 1913.

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TEJON GROUP AT TYPE LOCALITY.

STRATIGRAPHY.

The Tejon group at the type locality is a portion of an east-west strip which extends from Tunis Creek on the north flanks of the Tehachapi Mountains to a point about three miles southeast of Pattiway where it is cut off by the San Andreas Fault. The map (see Text Figure 1) which is adapted from the "Preliminary Report on the Geology and Possible Oil Resources of the South End of the San Joaquin Valley, Cal." by Robert Anderson shows the general distribution of the Tejon very satisfactorily.

The Tejon strata in the vicinity of Grapevine Creek rest upon a Basement Complex consisting of granitic rocks and associated schists. The beds in general have a steep north dip of 75° to 85° , but are disturbed in places so that the dip is reversed. The basal member, about 250 to 300 feet in thickness, consists of a very coarse conglomerate derived from the granitic rocks of the Basement Complex. This member is overlain by about 1000 to 1200 feet of thin bedded, brown sandstone with subordinate strata of dark gray, clay shale containing limestone nodules. The sandstone is, in places, conglomeritic and in one locality the dark gray pebbles of shale yielded a small *Pecten*. The occurrence of this *Pecten* suggests the deposition of earlier deposits which were completely removed during Eocene time. The uppermost strata—about 1200 feet in thickness—consist chiefly of light tan sandstone with subordinate strata of shale and brown sandstone. The total thickness of the Tejon group along Grapevine Creek (Cañada de las Uvas) is about 2500 feet. The Tejon is overlain by volcanic ash of Oligocene or Miocene age on the west side of Grapevine Creek. Mr. Bruce Martin states that the uppermost Tejon beds in Live Oak Creek are covered by a lava flow.

FAUNA

The middle portion of Tejon group in the vicinity of Grapevine Creek is particularly rich in upper Eocene species. The basal beds yielded a small fauna (Cal. Acad. Sci. locality 246) which consists of *Spondylus carlosensis*, *Barbatia*, sp., *Meretrix*, sp. and *Ostrea*, sp.

Beds about 300 feet above the base (Univ. of Cal. locality 458) yielded an excellent fauna. This fauna, however, does not differ essentially from that of the beds higher in the section. The faunas from several other localities which are listed below do not differ materially from one another but all appear to represent one phase only. This faunal unity is in consonance with the sedimentary record as Anderson²¹ described it. "The beds throughout possess a marked similarity and give every appearance of representing a period of continuous deposition in one basin. They are therefore to be regarded as making up a formation, and not a larger division of the geologic column."

The writer is in complete agreement with Anderson's views as expressed here in relation to the type Tejon. However, beds both higher and lower than the Eocene of Cañada de las Uvas occur in other parts of the state, notably in the vicinity of Mount Diablo, along Cantua Creek, Coalinga Quadrangle and at the Marysville Buttes. Owing to these facts the expression—Tejon group—is fully warranted upon both stratigraphic and faunal grounds.

The fauna of the type Tejon corresponds with zone 2²² of the Mt. Diablo section. This zone will be called henceforth, the *Rimella simplex* Zone, after a characteristic fossil in its fauna. It is characterized by the abundance of *Turritella uvasana*, *Rimella simplex*, *Meretrix ovalis*, *Macrocallista conradiana*, *Meretrix hornii*, and by the absence of the *Turbinolia pussilanima*, n. sp. and other species of Zone 1 of the Mount Diablo section, and *Siphonalia sutterensis*, *Venericardia planicosta merriami* and other members of the *Siphonalia sutterensis* fauna. The greatest extent of the Tejon Sea in California at this stage is represented graphically in the figure on the opposite page (see Text Figure 2). The fauna obtained from the type locality of the Tejon group is given below.

²¹ Anderson, Robert, Preliminary Report on the Geology and Possible Oil Resources of the South End of the San Joaquin Valley, Cal. Bull. 471, U. S. Geol. Surv., p. 118, 1912.

²² Dickerson, R. E. Note on the Faunal Zones of the Tejon Group, Univ. Calif. Publ. Bull. Dept. Geol., vol. 8, pp. 17-25, 1914.



TEXT FIGURE 2—Map of California showing probable extent of the Tejon Sea during the deposition of rocks which have yielded the *Rimella simplex* fauna. 1, Tejon at Lower Lake; 2, Tejon at Benicia; 3, Tejon vicinity of Mount Diablo; 4, Tejon of Coalinga region; 5, Tejon of the Santa Clara Valley of the South; 6, Tejon of the Santa Ana Mountains; 7, Tejon of San Diego; 8, Tejon in Round Valley, Mendocino County; 9, Type Locality of the Tejon group. This stage is the only one which is represented at San Diego and the Santa Ana Mountains.

[illegible]

LIST OF CALIFORNIA ACADEMY OF SCIENCES
LOCALITIES, VICINITY OF GRAPEVINE CREEK.

244. Tejon Quadrangle, Kern County, California, Tejon group. In east bank of Live Oak Creek about three-fourths of a mile from its mouth or from the edge of the San Joaquin Valley and about three miles due east of the mouth of Grapevine Canyon. Coll., Bruce Martin.

245. Tejon Quadrangle, Kern County, California. Tejon group. Along the east bank of a small gulch about one-fourth of a mile east of the pumping plant at the mouth of Grapevine Canyon, about 35 miles south of Bakersfield, California. The fossils were found in strata at an elevation of about 2000 feet, near the middle of the Tejon section. Coll., Bruce Martin.

246. Tejon Quadrangle, Kern County, California. Tejon group. In hard conglomeritic sandstone near the top of a small hill about 300 yards west of Grapevine Canyon and about one-half of a mile south of its mouth. Elevation 2800 feet. This locality is near the base of the Tejon. Coll., Bruce Martin.

DESCRIPTIONS OF UNIVERSITY OF CALIFORNIA
LOCALITIES IN THE VICINITY OF CAÑADA
DE LAS UVAS (GRAPEVINE CREEK).

451. Tejon Quadrangle. Tejon group. West side of Grapevine Creek, elevation 2500 feet, T. 10 N., R. 19 W., Mt. S. B. B. L. and M., N. of center of S. W. $\frac{1}{4}$, Sec. 20; $\frac{1}{4}$ mile north of Basement Complex-Tejon contact. Coll., R. E. Dickerson.

452. Tejon Quadrangle. Tejon group. On road in Grapevine Creek; S. W. $\frac{1}{4}$ of S. E. $\frac{1}{4}$ of Sec. 20, T. 10 N., R. 19 W., Mt. S. B., B. L. and M., elevation, 2000 feet. R. E. D. 530. Coll., R. E. Dickerson.

453. Tejon Quadrangle Tejon group. Grapevine Creek; T. 10 N., R. 19 W., Mt. S. B., B. L. and M., S. W. $\frac{1}{4}$, Sec. 29. 300 feet N. of Basement Complex-Tejon Contact; R. E. D. 531. Coll., R. E. Dickerson.

454. Mt. Pinos Quadrangle. Tejon group. On Tejon-Miocene contact, $\frac{1}{4}$ mile E. of Salt Creek and 100 yards S. of

Salt Creek on ridge; T. 10 N., R. 20 W., Sec. 33, Mt. S. B., B. L., and M. on north center section line. R. E. D. 532; Avicula Bed. Colls., Roy Cohn and R. E. Dickerson.

455. Tejon Quadrangle. Tejon group. On Tecuya Creek about $1\frac{3}{4}$ miles from mouth of canon; R. E. D. 533. Colls., Roy Cohn and R. E. Dickerson.

456. Tejon Quadrangle. Tejon group. On Tecuya Creek. 200 feet S. of red agglomerate of Miocene, near top of the Tejon Group. R. E. D. 534. Colls., Roy Cohn and R. E. Dickerson.

457. Tejon Quadrangle. Tejon group. On west side of Grapevine Canyon; elevation 2100 feet; 5 miles S. 8° W. of 1085 feet B. M.; 50 to 100 feet above Basement Complex-Tejon Contact. Coll., R. E. Dickerson.

458. Tejon Quadrangle. Tejon group. West side of Grapevine Creek, elevation 2050 feet; about $4\frac{1}{2}$ miles S. 6° W. of 1085 B. M.; about 400 feet (stratigraphic) above Basement Complex-Tejon contact. R. E. D. 536. Coll., R. E. Dickerson.

459. Tejon Quadrangle. Tejon group. $4\frac{1}{4}$ miles S. 9° W. of 1085 B. M., on west side of Grapevine Creek, elevation 2000 to 2100 feet. R. E. D. 537. This locality is near top of section about 1800 feet (stratigraphic) above base. Coll., R. E. Dickerson.

460. Tejon Quadrangle. Tejon group. 4 miles S. 10° W. of 1085 B. M., near top of Tejon Group; R. E. D. 538. Coll., R. E. Dickerson.

461. Tejon Quadrangle. Tejon group. $4\frac{1}{8}$ miles S. 15° W. of 1085 B. M. at Tejon-Miocene Contact. (Schizaster lecontei Merriam) R. E. D. 539. Coll., R. E. Dickerson.

462. Mt. Pinos Quadrangle. Tejon group. On Salt Creek. S. E. $\frac{1}{4}$ of N. W. $\frac{1}{4}$, Sec. 32, T. 10 N., R. 20 W., Mt. S. B., B. L. and M., on north side of Canyon, a branch of Salt Creek, 100 feet from bottom. R. E. D. 540. Coll., R. E. Dickerson.

463. Mt. Pinos Quadrangle. Tejon group. Salt Creek. S. E. $\frac{1}{4}$ of N. W. $\frac{1}{4}$ of Sec. 32, T. 10 N., R. 20 W., Mt. S. B., B. L. and M. R. E. D. 541. Colls., B. Parsons and R. E. Dickerson.

464. Mt. Pinos Quadrangle. Tejon group. Vicinity of Salt Creek. S. E. $\frac{1}{4}$ of N. W. $\frac{1}{4}$ of Sec. 32, T. 10 N., R. 20

W., Mt. S. B., B. L. and M. on north side of a branch of Salt Creek 150 feet above bottom. R. E. D. 541. Colls., B. Parsons and R. E. Dickerson.

465. Mt. Pinos Quadrangle. Tejon group. Vicinity of Salt Creek. S. E. $\frac{1}{4}$ of N. W. $\frac{1}{4}$ of Sec. 32, T. 10 N., R. 20 W., Mt. S. B., B. L. and M., 25 feet below hilltop and 75 feet below white Miocene conglomerate. R. E. D. 543. Colls., B. Parsons and R. E. Dickerson.

COWLITZ PHASE OF TEJON GROUP.

STRATIGRAPHY.

Dr. Weaver described the Cowlitz phase as follows: "In southern Lewis County, east of Little Falls, there exist shales and shaly limestones containing a fauna seemingly older than the typical Tejon, but more closely related to it than to the Martinez or lower Eocene of California. A very large number of the species are new and the fauna may represent a transition from the Martinez to the Tejon—a fauna which as yet is unknown in California. In order to distinguish this from the typical Tejon, the term Cowlitz formation is suggested.

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The Cowlitz formation contains the following fauna:

PELECYPODA

| | |
|---|--------------------------------------|
| <i>Barbatia morsei</i> Gabb | <i>Meretrix olequahensis</i> , n.sp. |
| <i>Cardium breweri</i> Gabb | <i>Ostrea fettkei</i> , n.sp. |
| <i>Cardium cooperi</i> Gabb | <i>Pecten cowlitzensis</i> , n.sp. |
| <i>Corbula</i> , sp. | <i>Placunanomia inornata</i> Gabb |
| <i>Crassatella washingtoniana</i> , | <i>Venericardia alticosta</i> Gabb |
| n.sp. | <i>Venericardia planicosta</i> Lam- |
| <i>Crassatella cowlitzensis</i> , n.sp. | arck. |

GASTROPODA

| | |
|------------------------------------|---|
| <i>Ancillaria bretzi</i> , n.sp. | <i>Fusus washingtoniana</i> , n.sp. |
| <i>Cassidaria washingtoniana</i> , | <i>Galerus excentricus</i> Gabb |
| n.sp. | <i>Hemifusus sopenahensis</i> , n.sp. |
| <i>Conus cowlitzensis</i> , n.sp. | <i>Hemifusus cowlitzensis</i> , n.sp. |
| <i>Cylichna costata</i> Gabb | <i>Hemifusus lewisensis</i> , n.sp. |
| <i>Fusus lewisensis</i> , n.sp. | <i>Hemifusus tejonensis</i> , n.sp. |
| <i>Fusus dickersoni</i> , n.sp. | <i>Hemifusus washingtoniana</i> , n.sp. |

| | |
|--|--|
| <i>Fasciolaria washingtoniana</i> , n.sp. | <i>Nassa packardi</i> , n.sp. |
| <i>Lunatia hornii</i> Gabb | <i>Naticina obliqua</i> Gabb |
| <i>Murex sopenahensis</i> , n.sp. | <i>Ranella washingtoniana</i> , n.sp. |
| <i>Murex cowlitzensis</i> , n.sp. | <i>Ranella cowlitzensis</i> , n.sp. |
| <i>Mitra washingtoniana</i> , n.sp. | <i>Rimella canalifera</i> Gabb var. elongata new var. |
| <i>Morio tuberculatus</i> Gabb var. | <i>Surcula cowlitzensis</i> , n.sp. |
| trituberculatus new var. | <i>Tritonium sopenahensis</i> , n.sp. |
| <i>Nassa eocenica</i> , n.sp. | <i>Turritella uvasana</i> Conrad. |

BRACHIOPODA

Rhynchonella washingtoniana, n.sp.

SHARKS' TEETH

There is a total of forty-five species occurring in this formation. Out of the total fauna thirty are new species. The base of this formation is unknown. Its known thickness is at least five hundred feet. Future studies may show this to be really a part of the Tejon formation".

Dr. Weaver's present opinion is that the Cowlitz phase is uppermost Tejon and that it is to be correlated with the *Siphonalia sutterensis* Zone.

Mr. Bruce Martin described conditions at the two principal collecting localities 182 and 183, Cal. Acad. Sci. as follows:

"Locality 182 is on the west bank of the Cowlitz River immediately south of the eastward bend about one and one-half miles east of Vader, Washington. This is Professor Weaver's University of Washington locality 1. The formation here consists of blue sandy clay or mudstone. There are a few prominent strata of concretionary sandstone interstratified with the clay. The strike is N. 40° W., dip 5°-10° N. The formation extends southward down the river for some distance and fossils may be obtained from the banks for a half mile or more. The tops of the hills between Vader (Little Falls) and Olequah are mantled with basalt and the sandstone is exposed only in the creeks which have cut through the lava cap.

Locality 183 is in the west bank of the Cowlitz River about one and three-fourths miles southeast of Vader (Little Falls), Washington, about one-half mile south of Locality 182".

It will be seen from this description that Locality 183 is stratigraphically lower than Locality 182. The stratigraphy around Vader is evidently not so simple as Martin's description quoted above might lead one to infer. Martin states that the strata at locality 184, another Tejon locality on Olequah Creek one mile north of Vader have a strike of N. 35° W. and a dip of 60° E. A plot of these localities about Vader shows that some faulting or acute folding has taken place between localities 184 and 182.

FAUNA

The following species have been identified from localities 182 and 183. The ones marked by a star were reported by Dr. Weaver but are not in the Academy collections.

LIST OF SPECIES FROM COWLITZ PHASE.

| | 182 | 183 | Weaver | Type Tejon |
|---|-----|-----|--------|------------|
| <i>Terebratulina washingtoniana</i> (Weaver)..... | × | | | × |
| <i>Acila</i> , n.sp..... | | × | | × |
| <i>Barbatia morsei</i> Gabb..... | | × | * | × |
| <i>Corbula hornii</i> Gabb..... | | × | | × |
| <i>Crassatellites Washingtoniana</i> Weaver..... | | | * | × |
| <i>Crassatellites grandis</i> (Gabb)..... | | × | | × |
| <i>Crassatellites cowlitzensis</i> (Weaver)..... | | | * | × |
| <i>Cardium breweri</i> Gabb..... | | × | | × |
| <i>Cardium Cooperii</i> Gabb..... | | | * | × |
| <i>Diplodonta polita</i> (Gabb)..... | × | | | × |
| <i>Glycimeris sagittata</i> (Gabb)..... | | × | | × |
| <i>Leda gabbi</i> Conrad..... | × | | | × |
| <i>Leda vaderensis</i> , n.sp..... | | × | | × |
| <i>Marcia quadrata</i> (Gabb)..... | × | × | | × |
| <i>Macrocallista</i> (?) <i>andersoni</i> , n.sp..... | × | | | × |
| <i>Macrocallista vaderensis</i> , n.sp..... | | × | | × |
| <i>Meretrix olequahensis</i> Weaver..... | | | | × |
| <i>Meretrix cf. ovalis</i> Gabb..... | | × | | × |
| <i>Nucula</i> , sp..... | × | | | × |
| <i>Ostrea fettkei</i> Weaver..... | × | × | | × |
| <i>Ostrea idriaensis</i> Gabb..... | | × | | × |
| <i>Pecten cowlitzensis</i> Weaver..... | | | * | × |
| <i>Psammobia</i> , sp..... | | × | | × |
| <i>Psammobia hornii</i> (Gabb)..... | × | | * | × |
| <i>Placunanomia inornata</i> Gabb..... | | × | | × |
| <i>Semele</i> (?) <i>diaboli</i> , n.sp..... | | × | | × |
| <i>Thracia dilleri</i> Dall..... | | × | | × |
| <i>Tellina sutterensis</i> Dickerson..... | × | | | × |
| <i>Tellina longa</i> Gabb..... | | × | | × |
| <i>Teredo</i> , sp..... | | × | | × |
| <i>Venericardia planicosta hornii</i> (Gabb)..... | × | × | | × |
| <i>Cadulus pusillus</i> (Gabb)..... | | × | | × |
| <i>Dentalium stramineum</i> Gabb..... | × | × | | × |
| <i>Ancillaria bretzi</i> Weaver..... | × | × | | × |
| <i>Amauropsis alveata</i> (Conrad)..... | × | | | × |
| <i>Amphissa eocenica</i> (Weaver)..... | | × | | × |
| <i>Amphissa packardii</i> (Weaver)..... | | × | | × |
| <i>Bursa washingtoniana</i> (Weaver)..... | × | × | | × |
| <i>Bursa cowlitzensis</i> (Weaver)..... | | × | | × |
| <i>Calyptrea excentrica</i> (Gabb)..... | × | × | | × |
| <i>Crepidula pileum</i> Gabb..... | × | × | | × |
| <i>Cylichna costata</i> Gabb..... | × | | | × |
| <i>Cancellaria stantoni</i> Dickerson..... | | × | | × |
| <i>Cantharus perrini</i> , n.sp..... | | × | | × |
| <i>Conus weaveri</i> , n.sp..... | × | | | × |
| <i>Conus cowlitzensis</i> Weaver..... | × | | | × |
| <i>Conus remondii</i> Gabb..... | × | | | × |

June 15, 1915.

LIST OF SPECIES FROM COWLITZ PHASE.—(Cont.)

| | 182 | 183 | Weaver | Type Tejon |
|--|-----|-----|--------|------------|
| <i>Drillia ornata</i> , n.sp. | × | | | |
| <i>Exilia perkinsiana</i> (Cooper) | × | | | × |
| <i>Exilia dickersoni</i> (Weaver) | × | × | | × |
| <i>Ficus mamillatus</i> Gabb. | × | × | | × |
| <i>Fusus washingtoniana</i> Weaver | × | | | |
| <i>Fusus lewisensis</i> Weaver | × | × | | |
| <i>Fusus willisi</i> , n.sp. | | | | |
| <i>Fasciolaria buwaldana</i> , n.sp. | × | | | |
| <i>Picopsis cowlitzensis</i> (Weaver) | × | | | × |
| <i>Galeodea tuberculata</i> (Gabb) | × | | | × |
| <i>Hemifusus sopenahensis</i> Weaver | × | | | |
| <i>Hemifusus lewisiana</i> Weaver | | × | | |
| <i>Hemifusus washingtoniana</i> (Weaver) | × | | | |
| <i>Hemifusus tejonensis</i> Weaver | | × | | |
| <i>Lunatia cowlitzensis</i> , n.sp. | × | | | |
| <i>Lunatia nuciformis</i> Gabb. | | × | | × |
| <i>Mitra washingtoniana</i> Weaver | × | × | | |
| <i>Murex packardi</i> , n.sp. | × | | | |
| <i>Murex sopenahensis</i> Weaver | × | | | × |
| <i>Melania fettkei</i> (Weaver) | × | × | | |
| <i>Melania packardi</i> , n.sp. | | × | | |
| <i>Melania vaderensis</i> , n.sp. | | × | | |
| <i>Monodonta wattsi</i> Dickerson | | × | | |
| <i>Neverita weaveri</i> , n.sp. | × | | | |
| <i>Neverita secta</i> Gabb. | × | | | × |
| <i>Neritina martini</i> , n.sp. | | × | | |
| <i>Nerita cowlitzensis</i> , n.sp. | | × | | |
| <i>Naticina obliqua</i> Gabb. | | × | | × |
| <i>Nyctilochus washingtoniana</i> (Weaver) | × | | | × |
| <i>Niso polito</i> Gabb. | × | | | × |
| <i>Odostomia</i> , n.sp. | | × | | × |
| <i>Olivella mathewsonii</i> Gabb. | | × | | × |
| <i>Pseudoliva inornata</i> , n.sp. | | × | | × |
| <i>Rimella simplex</i> Gabb. | × | × | | × |
| <i>Rimella elongata</i> (Weaver) | × | × | | |
| <i>Siphonalia bicarinata</i> , n.sp. | | × | | × |
| <i>Surcula washingtoniana</i> (Weaver) | × | | | × |
| <i>Surcula cowlitzensis</i> Weaver | × | | | × |
| <i>Turris pulchra</i> , n.sp. | × | | | |
| <i>Turris</i> , n.sp. | | × | | × |
| <i>Turris monolifera</i> Cooper | | × | | |
| <i>Turris</i> cf. <i>monolifera</i> Cooper | | × | | |
| <i>Turritella uvasana</i> Conrad | × | × | | × |
| <i>Turritella</i> , n.sp. | × | | | × |
| <i>Turritella</i> , n.sp. | | × | | × |
| <i>Triforis washingtoniana</i> , n.sp. | | × | | |
| <i>Urosalpinx hannibali</i> , n.sp. | × | × | | |

COMPARISON OF COWLITZ AND TYPE TEJON
FAUNAS

The close connection between the Cowlitz phase of the Washington Tejon and the fauna of the type Tejon is easily seen when the table of the Cowlitz fauna is studied. (See list above.) About 55 of a total of 95 species listed from Washington are found in the fauna of the type Tejon. Of the remainder, three are not specifically determined, and about 20 are represented by only one or two individuals. Such characteristic and most abundant species as *Acila gabbiana*, *Barbatia morsei*, *Corbula hornii*, *Crassatellites grandis*, *Cardium*

brewerii, *Cardium cooperii*, *Diplodonta polita*, *Glycimeris sagittata*, *Leda gabbi*, *Marcia quadrata*, *Ostrea idriaensis*, *Psammobia hornii*, *Placunanomia inornata*, *Tellina longa*, *Venericardia planicosta hornii*, *Cadulus pusillus*, *Dentalium stramineum*, *Amauropsis alveata*, *Bursa washingtoniana*, *Bursa cowlitzensis*, *Calyptrea excentrica*, *Crepidula pileum*, *Cylichna costata*, *Cancellaria stantoni*, *Conus weaveri*, *Conus remondii*, *Conus cowlitzensis*, *Exilia perkinsiana*, *Exilia dickersoni*, *Ficopsis cowlitzensis*, *Galeodea tuberculata*, *Lunatia nuciformis*, *Murex sopenahensis*, *Neverita secta*, *Naticina obliqua*, *Nyctilochus washingtoniana*, *Niso polito*, *Olivella mathewsonii*, *Rimella simplex*, *Surcula washingtoniana*, *Surcula cowlitzensis*, *Turris*, n. sp., *Turritella uvasana*, *Turritella*, n. sp., *Turritella*, n. sp., are found in both faunas. This list well illustrates the fact that characteristic, abundant species are best for correlation purposes and that a mere percentage method which does not consider the abundance of individual species is very apt to be unreliable. The faunal differences are no greater than one might expect from separation by several degrees of latitude.

SUMMARY

(1.) The fauna of the type locality of Tejon group is a unit and it corresponds to the *Rimella simplex* Zone of the Mount Diablo region.

(2.) The beds composing the Tejon of the type locality are likewise a formational unit, but upper Eocene strata both older and younger than these occur in other parts of California.

(3.) The Cowlitz phase of the Tejon of Washington appears to represent the same faunal facies as the fauna of the type Tejon, i. e., the *Rimella simplex* Zone is present in both localities.

DESCRIPTIONS OF SPECIES

Leda uvasana, new species

Plate 1, figures 2a, 2b

Shell of medium size, elongate, with a very small inconspicuous central beak; anterior dorsal margin slightly convex with a slight slope to a narrowly rounded anterior extremity; posterior dorsal margin concave, ending in a sharply pointed

rostrum; ventral margin very broadly rounded; escutcheon lanceolate, distinct; lunule indistinct. This species has less thickness than *L. gabbi* Conrad and quite a different shape. Its ribbing is somewhat finer. Figure 1, Plate 1 illustrates *L. gabbi* well and brings out the differences at a glance.

Dimensions:—Height of broken type, 10mm.; length, 18mm.; convexity, 2mm.

Type:—No. 250, and cotype, No. 251, Cal. Acad. Sci. Locality 244, Tejon Quadrangle, Kern County, California, Tejon group. In east bank of Live Oak Creek about three-fourths of a mile from its mouth or from the edge of the San Joaquin Valley, and about three miles due east of the mouth of Cañada de las Uvas (Grapevine Creek). Coll., Bruce Martin.

Named for its occurrence in the vicinity of Cañada de las Uvas.

***Leda vaderensis*, new species**

Plate 1, figure 3

Shell robust, thick, with prominent, central beak; anterior dorsal margin slightly convex, sloping toward a well rounded anterior; posterior dorsal margin concave; ventral margin convex resembling that of *L. gabbi* closely; decoration consisting of very fine, round concentric ribs. This species differs from *L. gabbi* in its finer ribbing, in its greater convexity, and in the central position of its beak.

Dimensions:—Height, 7mm.; length, 13mm.; convexity, 2mm.

Type:—No. 252, Cal. Acad. Sci. Locality 183, in the west bank of the Cowlitz River, about one and three-fourths miles southeast of Vader, Washington. Coll., Bruce Martin.

Named for its occurrence near Vader, Washington.

***Glycimeris ruckmani*, new species**

Plate 1, figures 5a and 5b

Shell of moderate size with acutely pointed beaks; dorsal margins sloping steeply to join a broadly rounded ventral margin; the posterior dorsal margin slightly convex and with a gentler slope than the straight anterior dorsal margin; decoration consisting of about 28 rounded radial ribs crossed by concentric growth lines; area semilunar and marked by impressed lines curving outward from the altitude line.

This species differs from *Glycimeris cor* in having a more pointed beak, in lack of hinge teeth in the central portion of its hinge and in general shape. *Glycimeris cor* Gabb is figured for comparison. (See Plate a, figure 6).

Dimensions:—Height of type, 19mm.; length, 17mm.; convexity, 6mm.

Type:—No. 11051, University of California. Locality 458, Tejon Quadrangle. Tejon group. West side of Grapevine Creek, elevation 2050 feet, about 4½ miles S. 6° W. of 1085 B. M.; about 400 feet (stratigraphically) above Basement Complex-Tejon contact. R. E. D. 536. Coll., R. E. Dickerson.

Named in honor of Mr. John Ruckman.

***Meretrix tejonensis*, new name**

Plate 3, figures 2a and 2b

Meretrix uvasana Gabb, *not* Conrad, Gabb, W. M., Geology of California, Palaeontology, vol. 1, pp. 163-164, 1864.

Gabb's description is as follows:

"Shell thick, oval, robust, a fourth longer than wide, very inequilateral; beaks large, strongly incurved, placed less than a third of the length from the anterior end; buccal margin prominently rounded below, deeply excavated under the beaks; cardinal margin sloping very convexly towards the posterior end, which is subtruncated. Surface marked by small lamelliform ribs, separated by spaces about equal to four times the thickness of the ribs themselves; the interspaces are sometimes plain, sometimes striated. Inner margin plain.

Localities: Abundant near Fort Tejon, whence it was described by Mr. Conrad; also found not rarely, near Martinez, and nearly everywhere in Division B.

This is the largest species of the genus, and one of the commonest fossils in California. The figure given in the Pacific Railroad Report is from a fragmentary specimen, and conveys a very incorrect idea of the outline of the shell. There can be no doubt of the identity of the present form with Mr. Conrad's species, since I collected numerous specimens myself, at the original locality; and this is the only species with the peculiar surface ornamentation, mentioned by Mr. Conrad, that has been found in California."

It appears that Gabb was mistaken concerning "the only species with the peculiar surface ornamentation," as the individuals figured as figures 3a and 3b on Plate 3 show. These forms are very close to Conrad's figure of *M. uvasana*, and the writer believes that the forms illustrated are cotypes of Conrad's species. All of the four specimens figured as 2a, 2b, 3a, 3b came from Cal. Acad. Sci. locality 244. On this account the writer proposes a new name for the species re-described by Gabb as *M. uvasana*.

***Macrocallista vaderensis*, new species**

Plate 3, figures 5a, 5b, 5c

Shell trigonal, with beak a third of shell length from broadly rounded anterior end; posterior dorsal margin sloping to a sharply pointed posterior; broadly rounded anterior extending from beak to nearly straight ventral margin; lunule and escutcheon, indistinct. The trigonal form of this species makes it easily distinguishable from other Eocene Veneridæ.

Dimensions:—Height, 19mm.; length, 26mm.; convexity, 7mm.

Type:—No. 267, and cotype No. 268, Cal. Acad. Sci. Locality 183, in the west bank of the Cowlitz River about one and three-fourths miles southeast of Vader, Washington. Coll., Bruce Martin.

Named for its occurrence near Vader, Washington.

***Macrocallista* (?) *andersoni*, new species**

Plate 4, figures 1a, 1b

Shell elliptical in outline; medium size; beak prominent, a third of shell length from anterior end; posterior dorsal margin nearly straight; posterior end subtruncate; anterior end well rounded; lunule and escutcheon distinct; a well marked shallow umbonal groove extending to the ventral margin near posterior end; hinge characters unknown; numerous lines of growth decorating shell. The umbonal groove is the unique character of this species and serves to distinguish it from other west coast venerid forms.

Dimensions:—Length, 39mm.; height, 25mm.

Type:—No. 269, Cal. Acad. Sci. Locality 244, Tejon Quadrangle, Kern County, California. Tejon group. In east bank of Live Oak Creek about $\frac{3}{4}$ mile from its mouth. Coll., Bruce Martin.

Named in honor of Mr. F. M. Anderson, Curator, Department of Invertebrate Paleontology, California Academy of Sciences.

***Tellina howardi*, new species**

Plate 4, figures 2a and 2b

Shell large, oval, compressed; beak anterior of center; anterior and posterior dorsal margins nearly straight sloping gently; anterior end rounded more broadly than posterior; ventral margin with very great curvature. This is the largest *Tellina* in the Tejon-Eocene.

Dimensions:—Length of broken type, 43mm.; height, 30mm.

Type:—No. 271, and cotype, No. 272, Cal. Acad. Sci. Locality 244, Tejon Quadrangle, Kern County, California. Tejon group. In east bank of Live Oak Creek about three-fourths of a mile from its mouth or from the edge of the San Joaquin Valley and about three miles due east of the mouth of Grapevine Canyon. Coll., B. Martin.

Named for Delle Howard Dickerson who has aided the writer in his paleontological studies.

***Semele diaboli*, new species**

Plate 4, figure 4

Shell of medium size; beak sub-central; anterior dorsal margin sloping gently to a well rounded anterior end; posterior dorsal margin sloping steeply to a sharply rounded posterior; decoration, concentric growth lines only.

Dimensions:—Length, 31mm.; height, 24mm.

Type:—No. 11052, University of California. Locality 469, Mount Diablo Quadrangle, Contra Costa County, California. Tejon group. Near middle of S. E. $\frac{1}{4}$ of Sec. 21, T. 1 S., R. 1 E., Mt. D. B. L. and M., elevation 1350 feet, on north side of ridge. Coll., R. E. Dickerson.

Named for the occurrence in the vicinity of Mount Diablo.

Corbula harrisi, new species

Plate 4, figure 6

Shell small, thick, subtrigonal, with beak central, slightly prosogyrate; anterior dorsal slope slightly steeper than the moderately steep posterior dorsal slope; base broadly rounded; posterior end sharply rounded; a faint umbonal slope extending to the point between the posterior end and the base; shell decorated by faint radial ribbing which is strongest at posterior end along the umbonal slope and by concentric growth lines. Interior of shell is unknown and hence generic reference is doubtful. This species is not so thick as *C. parilis* Gabb and its concentric ribbing is not so strong.

Dimensions:—Length, 6mm.; height, 4mm.; convexity, 1.5mm.

Type:—No. 275, Cal. Acad. Sci. Locality 244, Tejon Quadrangle, Kern County, California. Tejon group. In east bank of Live Oak Creek about three-quarters of a mile from its mouth. Coll., B. Martin.

Named in honor of Professor G. D. Harris of Cornell University.

Corbula uvasana, new species

Plate 4, figure 7

Shell small, inflated with central beak, anterior dorsal margin slightly concave with moderate slope to a subtruncate anterior end; posterior dorsal margin with slight slope to a broadly rounded posterior; ventral margin broadly rounded. Faint radial lines and feeble concentric growth lines decorate this shell. Interior unknown.

Dimensions:—Length, 7mm.; height, 5mm.; convexity, 2mm.

Type:—No. 276, Cal. Acad. Sci. Locality 244, Tejon Quadrangle, Kern County, California. Tejon group. In bank of Live Oak Creek about three-quarters of a mile from its mouth. Coll., Bruce Martin.

Named for its occurrence near Cañada de las Uvas.

Neverita weaveri, new species

Plate 4, figures 10a, 10b

Shell small, subglobose with very low spire of three whorls; aperture semilunar, entire; outer lip thin, curving backward; umbilicus completely covered in the type, a mature specimen, but partially open in young forms; outer lip and umbilicus in same plane which cuts axis of shell at a forty-five degree angle.

The umbilicus of this species resembles that of *N. callosa* Gabb very closely but its low spire renders it easily separable from *N. callosa*.

Dimensions:—Length, 9mm.; width of body-whorl, 11mm.

Type:—No. 278, and cotype, No. 279, Cal. Acad. Sci. Locality 183, in the west bank of the Cowlitz River about one and three-fourths miles southeast of Vader (Little Falls), Washington, about one-half mile south of Locality 182.

Named for Professor C. E. Weaver, University of Washington.

Lunatia cowlitzensis, new species

Plate 4, figures 12a, 12b

Shell of medium size, high with five rounded whorls; umbilical chink small, long, narrow; callus long, slightly widening above umbilical chink; aperture semilunar.

This species has apparently two different forms one of which is slightly higher than the other. Possibly these two forms represent sex differences.

This species has a higher spire than *L. hornii* Gabb, (See Plate 4, figure 4). It resembles *L. shumardiana* Gabb very closely but the callus appears to be slightly different.

Dimensions:—Length, 30mm.; width of body-whorl, 21mm.

Type:—No. 281, and cotype, No. 282, Cal. Acad. Sci. Locality 182, on the west bank of the Cowlitz River immediately south of the eastward bend about one and one-half miles east of Vader, Washington. This is Professor Weaver's University of Washington Locality 1.

Named for its occurrence on the Cowlitz River, Washington.

***Turritella uvasana bicarinata*, new variety**

Plate 5, figure 2

This variety which is found associated with the typical *T. uvasana* at Cal. Acad. Sci. Locality 244 differs from the typical form in that the lower portion of the whorls are marked by two unusually strong carinae with a thread between. Intergrades are found between this form and the typical *T. uvasana*. These two carinae give the whorls a form somewhat similar to *T. martinezensis* of the Martinez group and quite different from the well rounded whorls of the typical *T. uvasana*.

Type:—No. 285, Cal. Acad. Sci. Locality 244, Tejon Quadrangle, Kern County, California. Tejon group. In east bank of Live Oak Creek about three-fourths of a mile from its mouth or from the edge of the San Joaquin Valley and about three miles due east of the mouth of Grapevine Canyon. Coll., Bruce Martin.

***Turritella uvasana tricarinata*, new variety**

Plate 5, figure 4

This variety also occurs with the above described variety which it resembles closely but differs by having three strong carinae instead of two.

Type:—No. 287, Cal. Acad. Sci. Locality 244, Tejon Quadrangle, Kern County, California. Tejon group. In east bank of Live Oak Creek about three-fourths of a mile from its mouth or from the edge of the San Joaquin Valley and about three miles due east of the mouth of Grapevine Canyon. Coll., Bruce Martin.

***Nerita cowlitzensis*, new species**

Plate 5, figures 7a, 7b

Shell very small with spire immersed; whorls three, rapidly increasing in size; surface of subglobose body-whorl divided into three portions by a strong spiral line at the shoulder and a second medial one; mouth semilunar; outer lip thickened, dentate; callus heavy, closing umbilicus completely; beaded spiral threads crossed by axial ribs decorating shell.

This species is less angulated than *N. triangulata* Gabb and its spiral threads are beaded.

Dimensions:—Length, 7mm.; width of body-whorl, 8mm.

Type:—No. 290, Cal. Acad. Sci. Locality 183, in the west bank of the Cowlitz River about one and three-fourths miles southeast of Vader (Little Falls), Washington, about one-half mile south of Locality 182.

Named for its occurrence on Cowlitz River, Washington.

***Neritina martini*, new species**

Plate 5, figures 8a, 8b

Shell medium in size with two and a half whorls; spire immersed; body-whorl very wide, rounded to sub-quadrate, with flattened top which is perpendicular to axis of shell; outer lip sharp, smooth within, entire; callus large with straight interior edge which is slightly dentate; surface decorated by sinuous axial growth lines.

This is the first representative of this genus reported from the West Coast Eocene.

Dimensions:—Length, 18mm.; width of body-whorl, 21mm.

Type:—No. 291, Cal. Acad. Sci. Locality 183, in the west bank of the Cowlitz River about one and three-fourths miles southeast of Vader (Little Falls), Washington, about one-half mile south of Locality 182.

Named in honor of Mr. Bruce Martin who collected the species at its type locality.

***Rimella elongata* (Weaver)**

Plate 6, figure 2

Rimella canalifera elongata Weaver, C. E. "A Preliminary Report on the Tertiary Palaeontology of Western Washington". Bull. 15, Wash. Geol. Surv., pp. 37-38, 1912.

The specimen figured agrees with Weaver's description and since it came from the type locality of the species it is evidently the same. It differs so very much from *R. canalifera* Gabb that it was thought best to raise it to specific rank. Dr. Weaver pointed out these differences very well. "This variety is characterized by ten instead of six or seven whorls, by its more slender form, and differences in external ornamentation."

Unfortunately his figures do not correspond to the description. The number of axial ribs of this species is much greater than in *R. canalifera*. The differences between this species and *R. simplex* Gabb are readily seen upon comparing the figures. (See Plate 6, figures 1a, 1b).

***Cypræa mathewsonii* Gabb**

Cypræa Mathewsonii Gabb, W. M., Geol. Calif. Palæontology, vol. 2, p. 164, 1868.

Plate 6, figure 5

This small form is abundant at Cal. Acad. Sci. Locality 245. It differs from *C. bayerquei* Gabb, (See Plate 6, figure 4a, 4b) in its greater thickness and in its shorter length. It is not common at most Tejon localities and as far as known it is characteristic of the Rimella simplex Zone. *Cypræa bayerquei* has apparently the same upper limit.

***Melania packardi*, new species**

Plate 6, figure 6

Shell elongate, slender, with flat sided whorls; about twelve parallel axial ribs which are crossed by six or seven weaker spiral lines decorate each whorl; rectangular spaces between two sets of lines having greater length parallel to spiral lines; suture wavy, distinct.

This species is readily recognized by its characteristic decoration.

Dimensions:—Length of broken type, 18mm.; width of body-whorl, 8mm.

Type:—No. 299, Cal. Acad. Sci. Locality 183, in the west bank of the Cowlitz River about one and three-fourths miles southeast of Vader (Little Falls), Washington, about one-half mile south of Locality 182.

Named for Mr. Earl L. Packard who collected many specimens from this locality.

***Melania vaderensis*, new species**

Plate 6, figure 7

Shell elongate-conic with nearly flat sided whorls; whorls decorated by seventeen or eighteen slightly sinuous axial ribs crossed by four spiral lines of nearly equal strength; suture wavy, distinct.

This species differs from *M. packardi* in the decoration of its whorls and a greater apical angle.

Dimensions:—Length of broken type, 19 mm.; width of body-whorl, 6 mm.

Type:—No. 300, Cal. Acad. Sci. Locality 183, in the west bank of the Cowlitz River about one and three-fourths miles southeast of Vader (Little Falls), Washington, about one-half mile south of Locality 182.

Named for its occurrence near Vader, Washington.

***Ficopsis remondii* Gabb, *Ficopsis hornii* Gabb, *Ficopsis cooperii* Gabb, *Ficopsis cowlitzensis* (Weaver)**

Ficopsis remondii Gabb, W. M., Geol. Calif. Palaeontology, vol. 1, p. 87, 1864.

Ficopsis hornii Gabb, W. M., Geol. Calif. Palaeontology, vol. 1, p. 86, 1864.

Ficopsis cooperii Gabb, W. M., Geol. Calif. Palaeontology, vol. 1, p. 86, 1864.

Hemifusus cowlitzensis Weaver, C. E., Wash. Geol. Surv. Bull. 15, p. 45, 1912.

Plate 6, figures 8, 9, 10, 11, 12

This very natural group is represented in the Tejon fauna by *Ficopsis remondii* Gabb, *F. hornii* Gabb, *F. cooperii* Gabb and *F. cowlitzensis* (Weaver). Conrad also included *Ficus mamillatus* Gabb in this group as well, but it appears to belong to the genus *Ficus*, as it lacks the relatively higher spire of *Ficopsis*, its body-whorl is more globose and its outer lip has no tendency to become angulated.

Ficopsis remondii Gabb is sometimes almost without marked angulation but in general, the specimen figured (See Plate 6, figure 8) represents a typical form. This species lacks any marked nodosity at the shoulder or upon the two carinae below it.

Ficopsis cowlitzensis (Weaver) is an intermediate form, that is, it bears certain resemblances to *F. remondii* on the one hand and to *F. hornii* on the other. It differs from *F. remondii* in that its shoulder is more definitely set off and in that the carinae are more definite and are always nodose. Its nodes

are more numerous than those of *F. hornii*, its shoulder is more sloping and the three carinæ are equally spaced instead of having a markedly different spacing as in the other species.

Ficopsis cooperii is much closer to *F. hornii* than to other members of this genus, but its square shoulder is without even the small slope of *F. hornii*, its spiral threads are finer and the three rows of nodes are unequally spaced but in reverse order the two upper rows being the closer together.

The range of these species brings out some interesting relationships. *F. remondii*, *F. hornii* and *F. cowlitzensis* are associated at the type locality on the Cañada de las Uvas. *F. cooperii* and *F. remondii* are found at San Diego. The general assemblage of forms at San Diego and the type Tejon represent the same faunal zone. *Ficopsis cooperii* also occurs in the *Siphonalia sutterensis* Zone of Oregon. It is apparent from this distribution that these forms are not directly evolved in a simple time order, that is, one form does not appear to have originated from another but they appear to represent end members of branchings from a common ancestor of an earlier period and possibly sometime when well preserved species of this genus are found in the Martinez group, a more nearly complete history of the group may be written.

***Pseudoliva inornata*, new species**

Plate 7, figures 1a, 1b, 1c

Shell pyriform, solid with thick shell; six whorls; the flat sided spire forming a cone which rests upon the body-whorl whose upper portion has a slightly lesser slope than the spire; body-whorl slightly swollen, elongate; suture linear; canal short, reverted; siphonal fasciole moderately developed; decoration consisting of axial growth lines only.

The lack of marked decoration and the nearly smooth surface of the shell, and the elongate form are characters which separate this species from other West Coast Eocene forms belonging to the genus *Pseudoliva*.

Dimensions:—Length, 32 mm.; width of body-whorl, 18 mm.

Type:—No. 11053, University of California. Locality 458, Tejon Quadrangle. Tejon group. West side of Grapevine Creek, elevation 2050 feet, about four and one-half miles S.

6° W. of 1085 feet B. M.; about 400 feet above Basement Complex—Tejon contact. R. E. D. 536. Coll. R. E. Dickerson.

***Pseudoliva tejonensis*, new species**

Plate 7, figure 2

Shell pyriform, solid with thick shell substance; five whorls; the flat-sided spire whorls forming a cone which rests upon top of the body whorl; suture wavy, appressed and bordered by a rounded ridge on the body whorl; posterior sinus narrow, sharp and moderately deep; aperture oval with greatest width medial; inner lip thinly calloused; umbilicus imperforate; canal short, reverted; siphonal fasciole well developed; sulcus medial; decoration consisting of many fine spiral lines crossed by equally fine axial threads.

Dimensions:—Length, 39 mm.; width of body-whorl, 27 mm.

Type:—No. 308, Cal. Acad. Sci. Locality 245, Tejon Quadrangle, Kern County, California. Tejon group. Along the east bank of a small gulch about one-fourth of a mile east of the pumping plant at the mouth of Grapevine Canyon, about thirty-five miles south of Bakersfield, California. Coll., Bruce Martin.

Named for its occurrence in the Tejon group.

***Triforis washingtoniana*, new species**

Plate 6, figure 13

Shell elongate, conic with nine nearly plane-sided whorls, whorls decorated by three rows of nodes made by the crossing of three strong spiral lines and about eighteen axial ribs which are parallel to axis; one or two intercalary threads occur between the horizontal rows of nodes; suture indistinct.

Dimensions:—Length, 20 mm.; width of body-whorl, 45 mm.

Type:—No. 362, Cal. Acad. Sci. Locality 183, in the west bank of the Cowlitz River about one and three-fourths miles southeast of Vader (Little Falls), Washington, about one-half mile south of Locality 182.

Named for its occurrence in Washington.

Nyctilochus kewi, new species

Plate 7, figures 5a, 5b

Shell stout, with six whorls; spire only two-fifths the length of shell; the first two whorls smooth, the third, fourth and fifth whorls slightly convex and decorated by four strong spiral lines with a thread between each two and by fourteen axial ribs which make rounded nodes at the intersections with spiral ribs; of the spiral ribs, the lower two are the strongest and they occur near the base of the whorl at the place of greatest width; decoration of the body whorl similar to the decorated spire whorls; the largest spiral rib marking the shoulder which is located two-fifths of the whorl length below its sinuous suture; the spiral ribs above and below the shoulder not as well marked as those on the upper whorls; two rounded varices extending over the whorls; these varices about 180° apart being slightly discontinuous; canal short, twisted; mouth broadly oval. This species has a shorter spire than *Bursa cowlitzensis* (Weaver) or *Bursa washingtoniana* (Weaver). Its nodes are rounded instead of pointed like those of *Bursa washingtoniana* (Weaver).

Dimensions:—Length of spire, 21 mm.; width of body whorl, 15 mm.

Type:—No. 11054, Univ. Calif. Locality 458, Tejon Quadrangle, Kern County, California. Tejon group. West side of Grapevine Creek, elevation 2050 feet about four and one-half miles S. 6° W. of 1085 B. M.; about 400 feet (Stratigraphic) above Basement Complex—Tejon contact. R. E. D. 536. Coll., R. E. Dickerson.

Named in honor of Mr. Wm. Kew, who has assisted the writer upon many occasions in investigations of the Eocene of California.

Bursa washingtoniana (Weaver)

Ranella washingtoniana Weaver, C. E., Wash. Geol. Surv. Bull. 15, p. 41, 1912.

Plate 7, figures 4, 6

This species is a variable one and weathering sometimes obscures the finest spiral lines or removes them entirely. On this account the specimens collected at the type Tejon appear to be slightly different (See Plate 7, figure 4) from typical forms. Fortunately several specimens from Locality 245 are

available and the study of these forms demonstrates their identity with *Bursa washingtoniana*. One specimen from Locality 245 appears to have a slightly higher spire than the Washington forms but this specimen is a larger one than any of the forms from the north and comparative material shows that this is a variation due to growth. Younger individuals are the same in form and decoration as *B. washingtoniana*.

B. washingtoniana at the type locality of the species varies as respects the strength of nodes and position of varices. The closely allied forms *Nyctilochus californicus*, *N. hornii* and *N. washingtoniana* are introduced for comparison (See Plate 7, figures 7, 8, 9).

***Cantharus perrini*, new species**

Plate 7, figures 10a, 10b

Shell small, short, stout with large inflated body-whorl marked by strong spiral lines which alternate in size; whorls six; first two smooth; third, fourth and fifth whorls flat-sided and decorated by three strong spiral lines with two of lesser strength between; body-whorl decorated by eight or nine strong spiral lines with alternating threads; aperture oval; outer lip dentate and lirate within; siphonal fasciole well developed; umbilicus subimperforate.

Dimensions:—Length, 12 mm.; width of body-whorl, 7 mm.

Type:—No. 315 Cal. Acad. Sci. Locality 183, in the west bank of the Cowlitz River about one and three-fourths miles southeast of Vader (Little Falls), Washington. Coll., Bruce Martin.

Named in honor of Professor J. Perrin Smith of Stanford University.

***Chrysodomus ruckmani*, new species**

Plate 7, figure 11

Shell solid, spindle-shaped, with six or seven whorls; spire moderately elevated, consisting of five or six very slightly rounded whorls; whorls decorated by six to eight spiral lines with small threads in the interspaces; five incremental lines crossing the spiral lines; suture linear, distinct; body-whorl rounded and nearly twice as long as the spire; aperture large, widest in middle, and terminating in a twisted canal; outer lip simple; inner lip slightly incrustated.

This species resembles *C. mucronata* (Gabb) in decoration but its whorls are far less rounded and its spire is much shorter.

Dimensions:—Length of imperfect type, 22 mm.; width of body whorl, 11 mm.

Type:—No. 11055, Univ. California. Locality 452, Tejon group. Cañada de las Uvas, the type locality of this group. On road to Grapevine Creek, S. W. $\frac{1}{4}$ of S. E. $\frac{1}{4}$, Sec. 29, T. 10 N., R. 19 W. Coll., R. E. Dickerson.

Named for John Ruckman, who assisted the writer in identifying the fauna of this locality.

***Siphonalia bicarinata*, new species**

Plate 8, figures 1a, 1b, 1c, 1d

Shell, fusiform; whorls seven, decorated by two spiral rows of twelve nodes; shoulder of whorl distinct, nodose; portion between shoulder and wavy suture marked by spiral threads of sub-equal strength; portion below shoulder marked by ribs of variable strength; body-whorl large, with biangular outer lip.

The two rows of nodes of this species make it easily separable from *Siphonalia sutterensis* Dickerson. The young individuals exhibit less accentuated characters than the older. (See figures 1c, 1d.)

Dimensions:—Length, 20 mm.; width of body-whorl, 11 mm.

Type:—No. 316, and cotype, No. 317, Cal. Acad. Sci. Locality 183, in the west bank of the Cowlitz River about one and three-fourths miles southeast of Vader (Little Falls), Washington, about one-half mile south of locality 182. Coll., B. Martin.

***Molopophorus tejonensis*, new species**

Plate 8, figures 3a, 3b

Shell biconical with very short recurved canal; spire short, with five flat sided whorls; suture distinct, linear; bordered by a narrow but distinct collar; decoration of each spire whorl consisting of about seven spiral lines crossed by about thirty slightly sinuous lines; axial ribs, sub-equal in strength; small rounded nodes present at crossing of two sets of lines; decoration of body whorl similar except for three closely spaced

spiral lines which are found in the slight concavity of the body-whorl just below the suture; siphonal fasciole of two sharp ridges with smooth channel between; aperture semioval; outer lip thin, sharp; inner lip covered by a thin callus.

This species lacks the sharp axial ribs of *Molopophorus striata* (Gabb) but its spiral decoration is more pronounced. (See Plate 8, figure 3c for comparison.) Only one specimen of *M. striata* was found and that one is evidently immature. If more comparative material were available possibly it might be shown that *M. tejonensis* is merely a mature form of *M. striata*, but it was thought best to describe *M. tejonensis* as a new species as its characters are markedly different.

Dimensions:—Length, 20 mm.; width of body-whorl, 11 mm.

Type:—No. 320, Cal. Acad. Sci. Locality 245, along the east bank of a small gulch about one-fourth of a mile east of the pumping plant at the mouth of Grapevine Canyon, about 35 miles south of Bakersfield, California. Col., Bruce Martin.

Named for its occurrence in the Tejon group at its type locality.

Hemifusus sopenahensis Weaver

Hemifusus sopenahensis Weaver, C. E., Wash. Geol. Surv. Bull. 15, p. 44, 1912.

Plate 8, figures 2a, 2b

The young individuals of this species have characters like the genus *Nyctilochus*. The body-whorl in mature forms is more elongate and the axial ribbing less pronounced.

Hemifusus volutæformis, new species

Plate 8, figures 4a, 4b

Shell small, solid, with five or six distinctly angulated whorls; whorls of the spire decorated by thirteen or fourteen axial ribs and by equally spaced spiral lines. The shoulder of the penultimate whorl which is well preserved located at a point two-fifths the whorl-length below the suture; the slope between the appressed suture and the shoulder concave and covered by spiral lines; the body-whorl decorated similarly to the spire-

whorls; shoulder of the body-whorl only a slight distance below the suture; aperture, elongate-oval and widest at shoulder; canal slightly twisted.

Dimensions:—Length, 16 mm.; width of body whorl, 8 mm.

Type:—No. 11056, University of California. Locality 452, Tejon group, Cañada de las Uvas. On road in Grapevine Creek, S. W. $\frac{1}{4}$ of S. E. $\frac{1}{4}$, Sec. 29, T. 10 N., R. 19 W. Coll., R. E. Dickerson.

***Exilia waringi*, new species**

Plate 9, figure 3

Shell elongate-fusiform; number of whorls unknown; penultimate whorl marked by a concave surface just above middle; lower half of whorl nearly flat and parallel to the axis; decoration of lower half of whorl consisting of five closely spaced spiral lines crossed by about twenty axial, sinuous, ribs which become obsolescent near base of whorl; upper half of whorl decorated by three spiral lines with alternating threads crossed by strong axial ribs; body-whorl with similar decoration; aperture elongate-oval; outer lip simple; inner lip marked by five or six very faint lirations (?).

This species resembles *Cordiera microptygma* Gabb but the axial ribs are different in number and the form of whorl is not convex. The markings on the inner lip of *E. waringi* are probably spiral lines only and not lirations characteristic of the genus *Cordiera*.

Dimensions:—Length of broken type, 12 mm.; width of body-whorl, 4 mm.

Type:—No. 328, Cal. Acad. Sci. Locality 244, Tejon Quadrangle, Kern County, California, Tejon group. In east bank of Live Oak Creek about three-fourths of a mile from its mouth or from the edge of the San Joaquin Valley and about three miles due east of the mouth of Grapevine Canyon. Coll., Bruce Martin.

Named in honor of Mr. C. A. Waring of the California State Mining Bureau.

Whitneya ficus Gabb

Whitneya ficus Gabb, W. M., Geol. Calif. Palaeontology, vol. 1, p. 104, 1864.

Plate 9, figures 5a, 5b, 5c, 5d

This very characteristic Tejon species proves to be a form which varies greatly according to the stage of growth. The collection made by Mr. Martin at Cañada de las Uvas contains an excellent series which show growth stages very well. A young individual is marked by strong, quadrate axial ribs with flat interspaces of the same width while a youthful form is smooth on the back and has the quadrate ribs only on the body-whorl near the inner lip. A mature specimen is nearly smooth and is marked by faint spiral and axial threads only. Mature specimens differ somewhat in proportions. These may be sex differences.

Murex packardi, new species

Plate 9, figures 6a, 6b

Shell of medium size, fusiform, with five decidedly convex whorls; varices about three to each whorl but irregularly spaced; varices very characteristically ruffled; about twelve large, rugose, spiral lines cross the slightly sinuous varices; two well marked axial, nodose ribs found between the varices on body-whorl; canal nearly closed, narrow, twisted slightly to right.

Dimensions:—Length, 41 mm.; width of body-whorl, 25 mm.

Type:—No. 333, Cal. Acad. Sci. Locality 183, in the west bank of the Cowlitz River about one and three-fourths miles southeast of Vader (Little Falls), Washington, about one-half mile south of Locality 183. Coll., B. Martin.

Named in honor of Mr. Earl L. Packard whose collections at type locality of this species have greatly aided the writer.

Urosalpinx hannibali, new species

Plate 9, figures 7a, 7b

Shell fusiform with ten beautiful nearly continuous rounded axial ribs; whorls seven or eight in number, very convex and decorated by spiral lines which alternate in strength and by rounded ribs; aperture rounded, suddenly contracted

below into a short, narrow, twisted canal; inner lip slightly calloused.

Dimensions:—Length, 16 mm.; width of body whorl, 8 mm.

Type:—No. 334, Cal. Acad. Sci. Locality 182, on the west bank of the Cowlitz River immediately south of the eastward bend about one and one-half miles east of Vader, Washington. This is Professor Weaver's University of Washington locality 1. Coll., B. Martin.

Named for Mr. Harold Hannibal.

***Sucula cohni*, new species**

Plate 10, figure 1

Shell of moderate size; whorls decorated by about twenty rounded nodes crossed by backward bowing sinuous growth lines which indicate the former central position of the sinus; a narrow collar just below a wavy impressed suture marking each whorl; space between collar and nodose central shoulder markedly concave; spiral ornamentation consisting of numerous spiral lines which alternate in size; aperture elongate-oval; outer lip simple; inner lip slightly calloused.

Dimensions:—Length of broken type, 22 mm.; width of body-whorl, 8 mm.

Type:—No. 336, Cal. Acad. Sci. Locality 245, along the east bank of a small gulch about one-fourth of a mile east of the pumping plant at the mouth of Grapevine Canyon, about 35 miles south of Bakersfield, California. Coll., B. Martin.

Named in honor of Mr. Roy Cohn who accompanied the writer to the type locality.

***Surcula (Surculites) sinuata* Gabb**

Plate 10, figures 2a, 2b, 2c

Conus sinuatus Gabb, W. M., Geology of California, Palaeontology, vol. 1, p. 123, 1864.

Surcula (Surculites) sinuata Gabb, W. M., Geology of California, Palaeontology, vol. 2, pp. 150-151, 1869.

This species is another form which varies with its growth stages. The young individuals are slenderer and are marked by medium sized spiral lines which become obsolete in mature forms.

Drillia ornata, new species

Plate 10, figure 3

Shell elongated, fusiform; spire high; whorls eight, angular; suture distinct; surface marked by ten to twelve large rounded oblique ribs most prominent at shoulder and below, becoming obsolete above; these are crossed by numerous prominent, spiral ribs with very narrow interspaces; sinus located very slightly above shoulder; aperture elongate, wide above, narrow below.

This shell resembles *D. raricostata* Gabb in shape but its axial ribs are more numerous and its whorls are more angular.

Dimensions:—Length, 17 mm.; width of body-whorl, 6 mm.

Type:—No. 337, Cal. Acad. Sci. Locality, 182, on the west bank of the Cowlitz River immediately south of the eastward bend about one and one-half miles east of Vader, Washington. Coll., B. Martin.

Turris pulchra, new species

Plate 10, figures 4a, 4b

Shell fusiform with nine whorls; first four turbo-form, smooth; others sharply angulated by a shoulder a third of whirl below suture; decorated by twelve to fourteen sub-equal spiral lines which are slightly nodose where the fine sinuous axial ribs cross them; a beaded sutural collar occurring just below indistinct suture; aperture elongate with greatest width above, narrowing below into a slender canal; outer lip, thin; inner lip but slightly calloused.

Dimensions:—Length, 20 mm.; width of body-whorl, 6.5 mm.

Type:—No. 338, Cal. Acad. Sci. Locality 182, on the west bank of the Cowlitz River immediately south of the eastward bend about one and one-half miles east of Vader, Washington. Coll., B. Martin.

Surcula uvasana, new species

Plate 10, figure 10

Shell, spindle-shaped with seven or eight whorls; decoration of the penultimate whorl consisting of a tabulate, nodose, medial carina, two nodose spiral lines of equal strength below

the carina, a nodose spiral thread on the tabulation above the shoulder and a nodose spiral line above the carina and close to the wavy suture; body-whorl marked by a strong carina at the shoulder and by a nodose spiral line in its middle where a second angulation occurs; twelve to fifteen nodose spiral lines occurring in addition to these two prominent lines described above; mouth oval; outer lip simple. This species is easily recognizable on account of its nodose spiral lines.

Dimensions:—Length of broken type specimen, 22 mm.; width of body-whorl, 7 mm.

Type:—No. 11057, University of California. Locality 458, Tejon Quadrangle, Tejon group, west side of Grapevine Creek, elevation 2050 feet, about $4\frac{1}{2}$ miles S. 6° W. of 1085 B. M. about 400 feet (stratigraphic) above Basement Complex-Tejon Contact. Coll., R. E. Dickerson.

Named for its occurrence at the type locality of the Tejon on the Cañada de las Uvas.

Surcula io (Gabb)

Plate 10, figure 11

Fasciolaria io Gabb, W. M., Geology of California, Palaeontology, vol. 1, p. 101, 1864.

This species was described as a *Fasciolaria* but careful examination fails to reveal any traces of plications and the position of the sinus is that of the genus *Surcula*.

This species belongs to the same general section of *Surcula* as *Surcula washingtoniana* (Weaver), (See Plate 10, figures 7a, 7b), but details of sculpture readily separate them.

Fusus washingtoniana Weaver

Fusus washingtoniana Weaver, C. E., Wash. Geol. Surv. Bull. 15, p. 50, 1912.

Plate 9, figure 8

The beautiful specimen figured is larger and more nearly perfect than Weaver's type. It is very close to *Fusus merriami* Dickerson (ms.) of *Siphonalia sutterensis* Zone of the Marysville Buttes, but it differs somewhat in proportion and details of sculpture.

Fusus willisi, new species

Plate 11, figures 1a, 1b

Shell elongate-conic; number of whorls unknown; whorls convex, decorated by twelve nearly continuous axial ribs made nodose by intersection of eight strong, spiral lines; suture wavy, distinct; aperture elongate-oval; outer lip simple; inner lip slightly incrustated.

Dimensions:—Length of broken type, 17.5 mm.; width of body-whorl, 7 mm.

Type:—No. 345, Cal. Acad. Sci. Locality 182, on the west bank of the Cowlitz River immediately south of the eastward bend about one and a half miles east of Vader, Washington. Coll., B. Martin.

Named in honor of Mr. Bailey Willis of the United States Geological Survey whose excellent detailed mapping in Washington has greatly aided workers in this field.

Fasciolaria buwaldana, new species

Plate 11, figures 2a, 2b

Shell, fusiform with probably eight convex whorls; whorls slightly shouldered a short distance below a wavy, impressed suture; spire-whorls decorated by nine axial ribs crossed by seven, very wavy, spiral lines of equal size; body whorl decoration similar except that the spiral lines over the widest part of whorl alternate in strength; aperture elongate-oval, widest in middle, narrowing below into a slightly sinuous canal of medium length. This species also occurs at Cal. Acad. Sci. Locality 245.

Dimensions:—Length, 19.5 mm.; width of body-whorl, 7.5 mm.

Type:—No. 346, Cal. Acad. Sci. Locality 182, on the west bank of the Cowlitz River immediately south of the eastward bend about one and one-half miles east of Vader, Washington. Coll., B. Martin.

Named for Mr. John P. Buwalda who spent a season collecting in the Washington formations for the California Academy of Sciences.

Fasciolaria sinuata Gabb

Fasciolaria sinuata Gabb, W. M., Geology of California, Palaeontology, vol. 1, p. 101, 1864.

Plate 11, figures 3a, 3b

This species is slightly more robust in young individuals than in older forms. The characteristic lirations in this species can only be discerned as a rule by breaking a specimen so that the spire portion of the columella can be examined, as the lirations on the outer lip are lacking. This form is very abundant at the type locality of the Tejon.

Conus californiana (Conrad)

Plate 11, figure 6

Volutilithes californiana Conrad, Pacific R. R. Report, vol. 5, p. 322, 1855.

Not *Conus remondii* Gabb, Rept. Geol. Surv. of California, Palaeontology, vol. 2, p. 122, 1869.

The specimen figured is without much doubt Conrad's form. Gabb described another *Conus* as *C. remondii* and placed this species in synonymy. Gabb's collections from the type Tejon were evidently not as exhaustive as he thought as he failed to find other forms which Conrad described.

This species has fewer nodes than *C. remondii* (See Plate 11, figure 7) and its spire height is greater. It differs from *C. cowlitzensis* Weaver (See Plate 11, figure 8) in having a shorter spire and a lesser number of nodes. The space between the suture and shoulder of this form is nearly flat while the corresponding space on *C. cowlitzensis* is decidedly concave.

Conus weaveri, new species

Plate 11, figure 10

Shell small, wide, short, with six whorls; decoration consisting of numerous spiral lines most prominent on lower part of body-whorl.

This species is easily distinguished from *C. hornii* (See Plate 11, figures 9a, 9b, 9c) by its greater breadth and by its marked spiral lines. Its lack of nodes renders it easily separable from *C. cowlitzensis*, *C. californiana*, and *C. remondii*.

Dimensions:—Length, 15.5; width of body-whorl, 9.5 mm.

Type:—No. 356, Cal. Acad. Sci. Locality 182, on the west bank of the Cowlitz River immediately south of the eastward bend about one and one-half miles east of Vader, Washington. Coll., B. Martin.

Named in honor of Professor C. E. Weaver.

Mitra uvasana, new species

Plate 11, figures 13a, 13b

Shell of medium size; elongate, spindle-shaped, the spire being a third the total length of shell; spire-whorls, probably eight or nine in number, flat sided, increasing slowly in size; suture impressed; body-whorl slightly convex with constriction three-fourths of whorl-length below suture; shell decorated by many fine ribbon-like spiral ribs. This species differs from *Mitra washingtoniana* Weaver and *M. simplicissima* Cooper in the greater length of spire and its marked ribbing.

Dimensions:—Length, 29 mm.; width of body-whorl, 11 mm.

Type:—No. 358, Cal. Acad. Sci. Locality 245, Tejon Quadrangle, Tejon group. Along the east bank of a small gulch about one-fourth of a mile east of the pumping plant at the mouth of Grapevine Canyon, about 35 miles south of Bakersfield, Cal. Coll., B. Martin.

Voluta slevini, new species

Plate 11, figure 16

Shell fusiform, with very rounded body-whorl; number of whorls unknown; decoration on body-whorl consisting of ten to fifteen strong spiral lines crossed by twenty axial ribs of equal strength; rounded nodes found at crossing of two sets of decoration; aperture oval; outer lip thin; inner lip bearing at least five plaits of equal size.

Dimensions:—Width of body-whorl, 9 mm.

Type:—No. 362, Cal. Acad. Sci. Locality 244, Tejon Quadrangle, Kern County, California, Tejon group. In east bank of Live Oak Creek about three-fourths of a mile from its mouth or from the edge of the San Joaquin Valley and about three miles due east of the mouth of Grapevine Canyon. Coll., B. Martin.

Named for Mr. Joseph R. Slevin, assistant curator of herpetology, Cal. Academy of Sciences, who assisted Mr. Bruce Martin in collecting at the type locality.

***Voluta martini*, new species**

Plate 11, figures 14a, 14b

Shell large, nodose; number of whorls unknown; penultimate whorl decorated by eight or nine sharply pointed nodes which are situated on a shoulder two-thirds of the whorl-length below a wavy irregular suture; space between these nodes and the suture of the preceding whorl smooth and slightly concave; body-whorl elongate with shoulder situated about one-fourth of whorl-length below suture; shoulder decorated by eight nodes similar to those of the penultimate whorl; body-whorl decorated by growth lines only; mouth elongate, oval; outer lip simple; inner lip marked by four strong folds, the anterior fold being the strongest; canal short, twisted. This species is easily distinguished from *V. lawsoni* Dickerson by its more elongate form. Two specimens were found by Mr. Martin.

Dimensions:—Length of broken specimen, 38 mm.; width of body-whorl, 20 mm.

Type:—No. 360, Cal. Acad. Sci. Locality No. 244, in the east bank of Live Oak Creek about three-quarters of a mile from its mouth. This locality is about three miles due east of the mouth of Grapevine Canyon, Tejon group, vicinity of Type Locality. Coll., Bruce Martin, for whom the specimen is named.

***Voluta*, species**

Plate 11, figure 15

An immature form which is apparently new was found at Cal. Acad. Sci. Locality 244. The whorls of this form are decorated by twenty sharp axial ribs crossed by equally spaced spiral threads. Four very prominent plaits are formed on the inner lip. Length of specimen is 7 mm.

EXPLANATION OF PLATE 1

Fig. 1. *Leda gabbi* Conrad, $\times 3$. Figured specimen is from University of California Locality 672.

Fig. 2a. *Leda uvasana*, new species, $\times 2$. Type.

Fig. 2b. *Leda uvasana*, new species, $\times 2$.

Fig. 3. *Leda vaderensis*, new species, $\times 2$. Type.

Fig. 4. *Arca hornii* Gabb, $\times 2$. A common species in the Tejon group. Figured specimen is from University of California Locality 672.

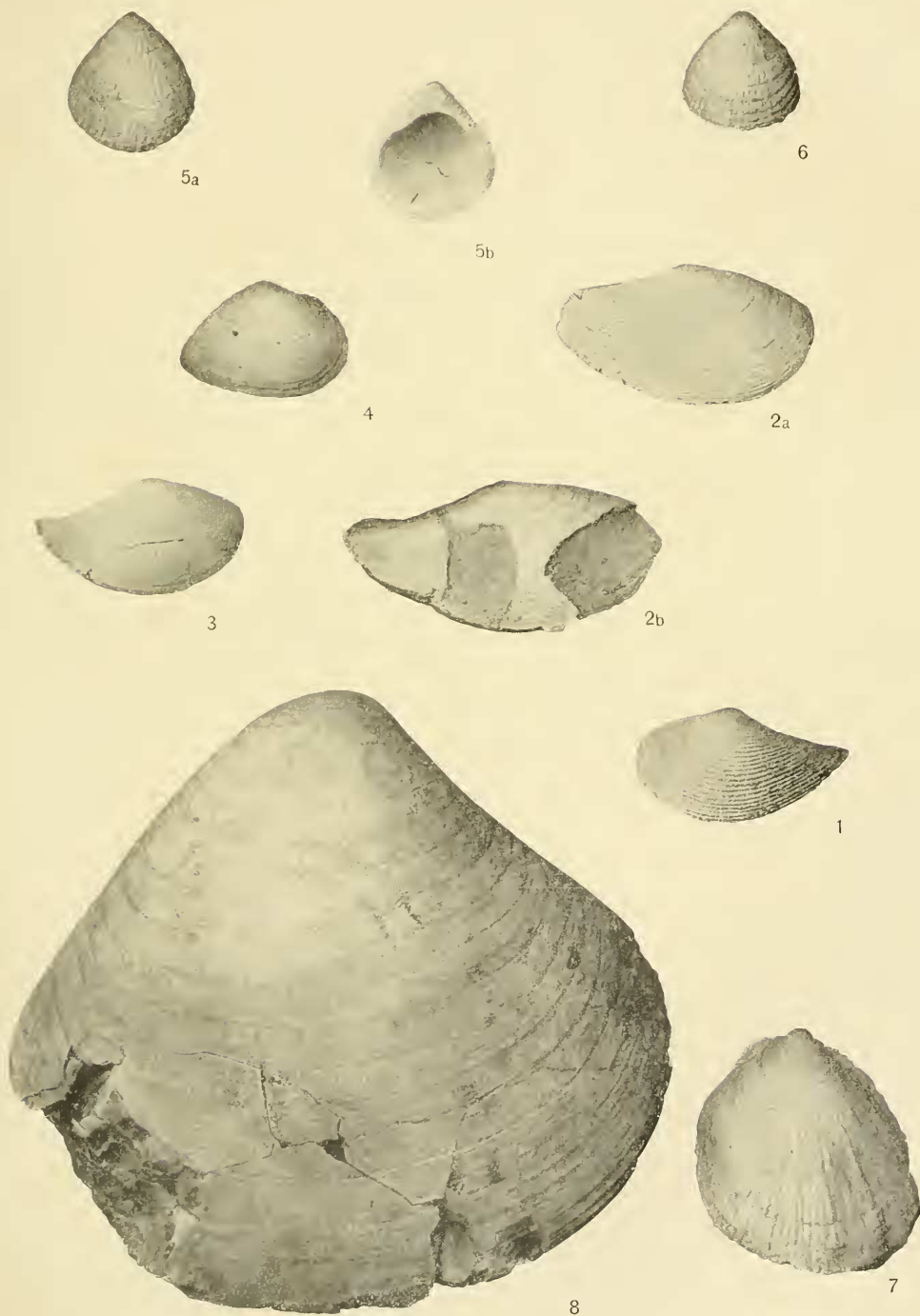
Fig. 5a. *Glycimeris ruckmani*, new species, $\times 1$. Type.

Fig. 5b. *Glycimeris ruckmani*, new species, $\times 1$.

Fig. 6. *Glycimeris cor* Gabb, $\times 1$. This is an unusually large specimen of this species and is introduced for comparison with *G. ruckmani*, new species.

Fig. 7. *Spondylus carlosensis* Anderson, $\times 1$. This is one of the few species from basal beds of the Tejon group, type locality.

Fig. 8. *Crassatellites grandis* Gabb, $\times 1$. This species is also found in the Martinez group, lower Eocene. It is very abundant at some Tejon localities and is one of the few large pelecypods in the Tejon fauna.



EXPLANATION OF PLATE 2

Fig. 1a. *Crassatellites grandis* Gabb, $\times 1$. The specimen figured is from California Acad. Sci. Locality 183.

Fig. 1b. *Crassatellites grandis* Gabb, $\times 1$. View showing hinge of specimen figured as Fig. 1a.

Fig. 2. *Crassatellites uvasana* Gabb, $\times 2$. Figured specimen from Cal. Acad. Sci. Locality 245, is a common Tejon species.

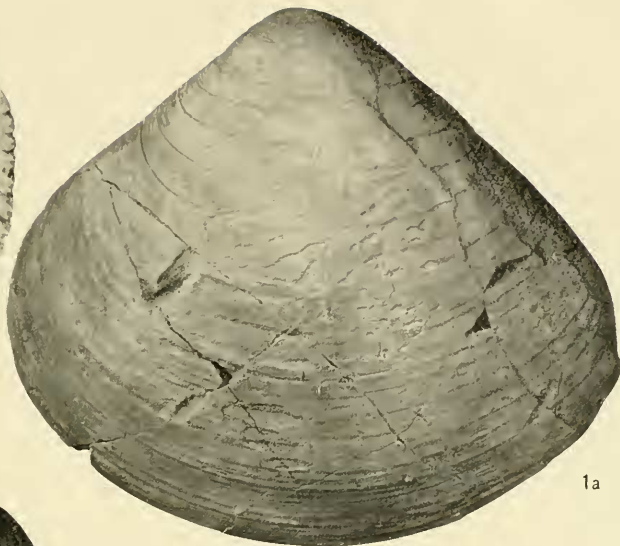
Fig. 3a. *Cardium breweri* Gabb, $\times 2$. This specimen from Cal. Acad. Sci. Locality 183 is slightly longer than the species found at Cañada de las Uvas. It may prove to be a subspecies.

Fig. 3b. *Cardium breweri* Gabb, $\times 2$. Hinge view of specimen figured as Fig. 3a.

Fig. 4. *Lucina cumulata* Gabb, $\times 3$. This species probably belongs to the genus *Divaricella* but since its hinge is unknown it is thought best to let the old reference remain until better material is found.



3b



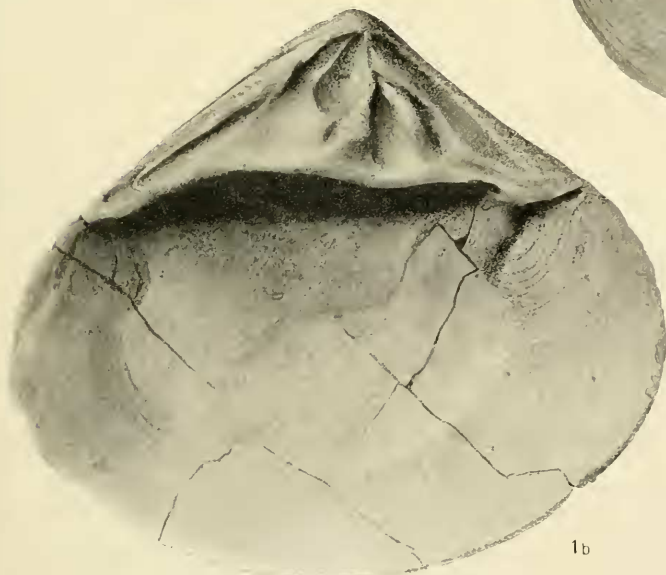
1a



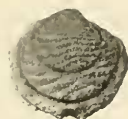
3a



2



1b



4

EXPLANATION OF PLATE 3

Fig. 1a. *Macrocallista conradiana* (Gabb), $\times 2$. This species was described as *Tapes conradiana*. It is a very common form throughout the Tejon group of California. The figured specimen is from Cal. Acad. Sci. Locality 244.

Fig. 1b. *Macrocallista conradiana* (Gabb), $\times 2$. Umbone view of specimen from Cal. Acad. Sci. Locality 244.

Fig. 1c. *Macrocallista conradiana* Gabb, $\times 1$. Hinge view of large specimen from Locality 244.

Fig. 2a. *Meretrix tejonensis*, n. nom., $\times 1$.

Fig. 2b. *Meretrix tejonensis*, n. nom., $\times 2$. This species was identified and redescribed by Gabb as *Meretrix uvasana* Conrad but he really had not obtained Conrad's cotype.

Fig. 3a. *Meretrix uvasana* Conrad, $\times 1$. Figured specimen is from Cal. Acad. Sci. Locality 244.

Fig. 3b. *Meretrix uvasana* Conrad, $\times 1$.

Fig. 4. *Meretrix ovalis* Gabb, $\times 1$. From Cal. Acad. Sci. Locality 245.

Fig. 5a. *Macrocallista vaderensis*, new species, $\times 1$. Type. From Cal. Acad. Sci. Locality 183.

Fig. 5b. *Macrocallista vaderensis*, new species, $\times 1$. View showing interior of type specimen.

Fig. 5c. *Macrocallista vaderensis*, new species, $\times 1$. View of interior of a small left valve from Cal. Acad. Sci. Locality 183.



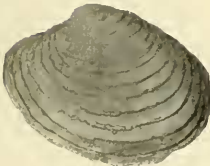
1c



2b



1b



3b



1a



5a



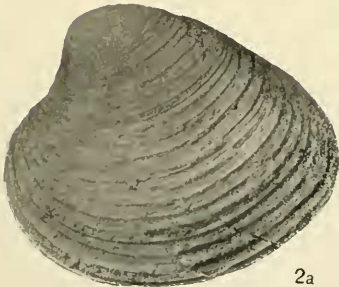
3a



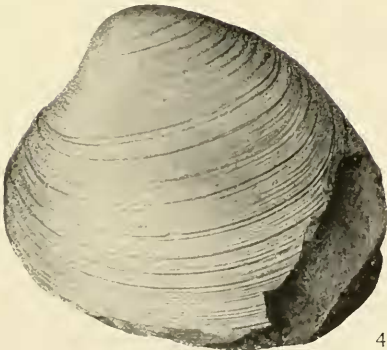
5c



5b



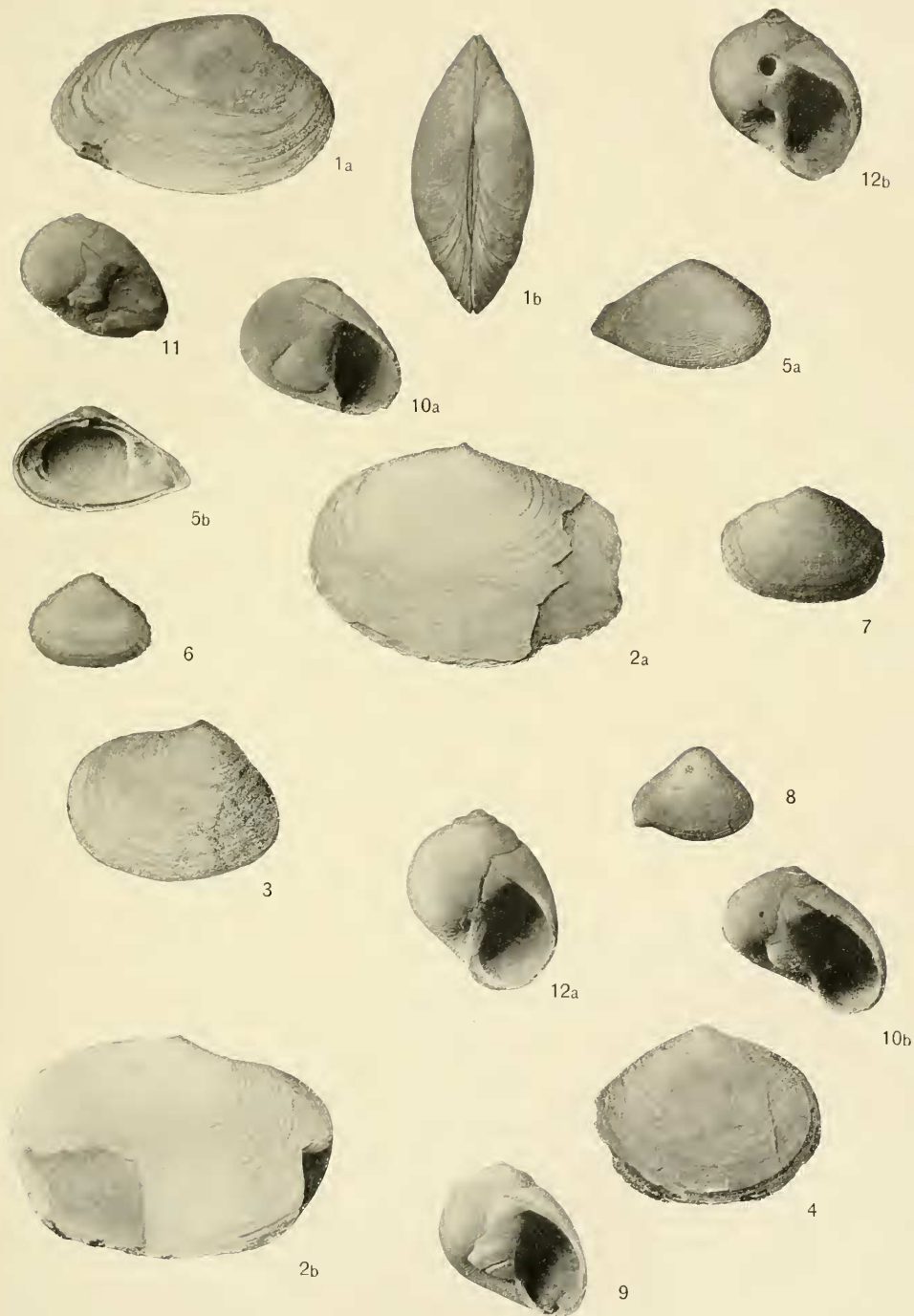
2a



4

EXPLANATION OF PLATE 4

- Fig. 1a. *Macrocallista* (?) *andersoni*, new species, $\times 1$. Type.
Fig. 1b. *Macrocallista andersoni*, new species, $\times 1$. Umbone view of species from Cal. Acad. Sci. Locality 183, Cowlitz phase, Washington.
Fig. 2a. *Tellina howardi*, new species, $\times 1$. Type.
Fig. 2b. *Tellina howardi*, new species, $\times 1$.
Fig. 3. *Tellina californica* Gabb, $\times 2$.
Fig. 4. *Semele diaboli*, new species, $\times 1$. Type.
Fig. 5a. *Corbula hornii* Gabb, $\times 2$. This species is introduced for comparison with *Corbula harrisi*, new species, and *Corbula uvasana*, new species.
Fig. 5b. *Corbula hornii* Gabb, $\times 2$. Interior of same specimen figured as Fig. 5a.
Fig. 6. *Corbula harrisi*, new species, $\times 2$. Type.
Fig. 7. *Corbula uvasana*, new species, $\times 2$. Type.
Fig. 8. *Corbula parilis* Gabb, $\times 2$. View of specimen from Marysville Buttes Tejon.
Fig. 9. *Neverita secta* Gabb, $\times 1$. From Cal. Acad. Sci. Locality 182.
Fig. 10a. *Neverita weaveri*, new species, $\times 2$. Type.
Fig. 10b. *Neverita weaveri*, new species, $\times 3$. Cotype showing young form with small umbilicus.
Fig. 11. *Lunatia hornii* Gabb, $\times 1$. Specimen from Cal. Acad. Sci. Locality 245.
Fig. 12a. *Lunatia cowlitzensis*, new species, $\times 1$. Type.
Fig. 12b. *Lunatia cowlitzensis*, new species, $\times 1$. Cotype showing mouth view of broad variety.



EXPLANATION OF PLATE 5

Fig. 1a. *Turritella uvasana* Conrad, $\times 2$. Mouth view of a beautiful specimen from Univ. of California Locality 672.

Fig. 1b. *Turritella uvasana* Conrad, $\times 1$. Cal. Acad. Sci. Locality 244.

Fig. 1c. *Turritella uvasana* Conrad, $\times 1$. Back view showing variation in strength of spire ribbing.

Fig. 2. *Turritella uvasana bicarinata*, new variety, $\times 1$. View of type showing two well marked carinae, Cal. Acad. Sci. Locality 244.

Fig. 3. *Turritella uvasana* Conrad, $\times 1$. This specimen from Locality 244 appears to be intermediate between the specimen figured as Fig. 2a and specimen in Fig. 1c.

Fig. 4. *Turritella uvasana tricarinata*, new variety, $\times 1$. Type.

Fig. 5a. *Naticina obliqua* Gabb, $\times 2$. Cal. Acad. Sci. Locality 182.

Fig. 5b. *Naticina obliqua* Gabb, $\times 2$. Mouth view of same specimen figured as Fig. 5a.

Fig. 6a. *Crepidula*, new species, $\times 2$.

Fig. 6b. *Crepidula*, new species, $\times 2$. Back view of same specimen, from Cal. Acad. Sci. Locality 182.

Fig. 7a. *Nerita cowlitzensis*, new species, $\times 2$. Mouth view of type.

Fig. 7b. *Nerita cowlitzensis*, new species, $\times 2$. Back view of type.

Fig. 8a. *Neritina martini*, new species, $\times 1$. Type.

Fig. 8b. *Neritina martini*, new species, $\times 1$. Back view of type.

Fig. 9. *Amauropsis alveata* (Conrad), $\times 1$. Back view of an unusually large specimen of this characteristic Tejon species.

Fig. 10a. *Odostomia*, new species, $\times 3$. Specimen from Cal. Acad. Sci. Locality 183.

Fig. 10b. *Odostomia*, new species, $\times 3$. View of a larger specimen.

